APRIL/MAY 2024

23PPH12 — CLASSICAL MECHANICS AND RELATIVITY

Time : Three hours Maximum : 75 marks

PART A — (10 × 2 = 20 marks)

Answer ALL questions.

1. Define the center of mass of a system of particles.
2. Define virtual displacement.
3. State D'Alembert's principle.
4. State the expression for the Lagrangian equation of motion for Atwood's machine.
5. Define phase space.
6. Define generalized momentum.
7. Differentiate stable and unstable equilibrium.
8. What is mode of vibration?
9. What is meant by an inertial frame of reference?
10. Write down the applications of Minkowski's space.

PART B — (5 × 5 = 25 marks)

Answer ALL questions.

11. (a) What are constraints? Explain the types of constraints with examples.

Or

(b) Explain the principle of virtual work.

12. (a) Obtain the Lagrange equation of motion from D'Alembert's principle.

Or

(b) Derive an expression for the Lagrange equation of motion for the spherical pendulum.

13. (a) State and prove the conservation of angular momentum.

Or

(b) Derive an expression for the motion of a particle in a central force field from Hamiltonian formulation.

14. (a) Obtain the Lagrangian equation for small oscillations.

Or

(b) Explain the frequencies of normal modes.

15. (a) State the Lorentz coordinate transformation and deduce the correct relativistic formula for the transition between two inertial frames.

Or

(b) What is length contraction and time dilation in relativistic mechanics?

PART C — (3 × 10 = 30 marks)

Answer any THREE questions.

16. State and prove the conservation laws for a system of particles in classical mechanics.

17. Derive the expression for the Lagrangian equations of motion for conservative systems.

18. Deduce the Hamiltonian function and Hamilton's canonical equations of motion.

19. Derive an expression for the small oscillation of linear triatomic molecules.

20. Deduce the expression for Einstein's mass-energy relation.

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